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Publication No. 85-e15

WA-13-0030

STATE OF WASHINGTON

DEPARTMENT OF ECOLOGY

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MEMORANDUM
July 22, 1985

To: Tom Eaton

Through: Bill Yake BY

From: Art Johnson AJ

Subject: Receiving Environment Survey in Budd Inlet at McFarland/Cascade, February 13, 1985

ABSTRACT

Samples of creosote, ground water, marine discharges, and intertidal sediment at the McFarland/Cascade wood-treating facility in Olympia, Washington, on Budd Inlet were analyzed to determine the nature and extent of contamination by creosote and pentachlorophenol. Aromatic hydrocarbons indicative of creosote were detected in all media. Pentachlorophenol was detected in water only. The intertidal sediments near McFarland/Cascade are potentially toxic to marine life. The concentrations of polynuclear aromatic hydrocarbon observed within the limited area of intertidal sediment surveyed are among the highest so far reported for Puget Sound.

INTRODUCTION

In response to your request, Dale Norton and I conducted a survey on February 13, 1985, in the intertidal zone around McFarland/Cascade's wood-treating facility in Olympia on Budd Inlet. The objectives of the survey were to determine if there were ongoing discharges of creosote, pentachlorophenol, or metals from this site and if there was evidence of sediment contamination. The survey was intended to be preliminary in nature and result in recommendations for additional work, if warranted. The results of our survey follow.

SAMPLING

Figure 1 shows the locations where samples were collected. Three discharges were sampled; McFarland/Cascade's stormwater discharge to East Bay (NPDES No. WA-000101-5), a bank seep near the permitted discharge, and an off-site storm drain discharging to West Bay. The West Bay discharge was sampled because it is in communication with contaminated ground water beneath McFarland/Cascade. [This communication was apparently established when a drain for the East Bay Marina project was dug along the McFarland/Cascade south property line in 1983 (R. Pierce, personal communication). A December 1983 water sample from the West Bay discharge (lab no. 40566) collected by the WDOE Southwest Regional Office and analyzed at the EPA/WDOE Manchester laboratory had a polynuclear aromatic hydrocarbon (PNA) concentration of 193,000 ug/L.]

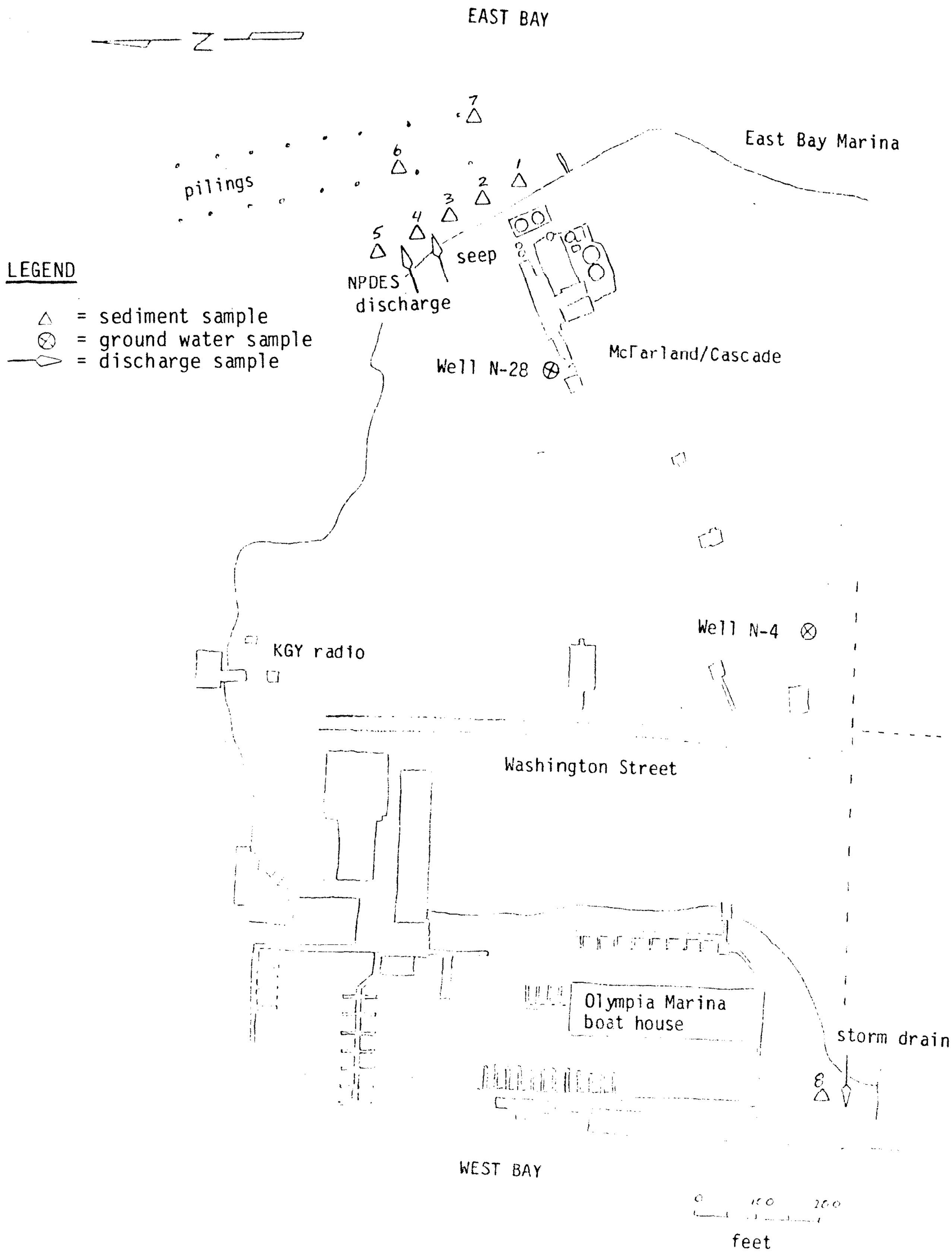

Figure 1. Locations of samples collected by WDOE on February 13, 1985, at McFarland/Cascade's wood-treating facility on Budd Inlet.

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Seven sediment samples were collected in the East Bay intertidal zone. Five of these were in a transect about 20 yards off the riprap bank that forms the northeast border of McFarland/Cascade. Two more sediment samples were collected outside this transect, about 50 yards from the bank. One sediment sample was also taken in West Bay next to the outfall of the above-mentioned storm drain.

To better relate results from analysis of these samples to the substantial on-site contamination already documented in the preliminary ground water evaluation (Applied Geotechnology, 1984), samples of ground water from monitoring wells designated N-4 and N-28, and a sample of creosote from Tank No. 2 were also collected. These wells were selected because of the high contaminant concentrations found by Applied Geotechnology and their proximity to the discharges and sediments being sampled. This shallow aquifer is apparently completely isolated from local water supply wells (Applied Geotechnology, 1984).

Water was collected as grab samples in one-gallon glass jars with teflon-lined lids (priority pollutant acid/base-neutral compounds), 40 mL glass vials sealed with teflon septums (priority pollutant purgeable organics), one-pint polyethylene cubitainers (copper, chromium, arsenic), one-half-liter polyethylene bottles (pH, specific conductivity, total suspended solids), and 250 mL polyethylene bottles with 2 mL H_2SO_4 as preservative (total organic carbon). Flows were instantaneous measurements taken with a Marsh-McBirney magnetic flow meter, or, alternatively, with a bucket and stopwatch. (Because of analytical problems experienced at the EPA/WDOE Manchester laboratory, the metals data on discharges are from a second set of water samples collected April 24, 1985.)

The ground water wells were purged by pumping with a peristaltic pump and teflon tubing until specific conductivity stabilized. This required removing about four well volumes from each well. New tubing was used for each well. Samples were taken with 1000 cc teflon bailers (Johnson UOP) on monofilament lines. The distance from the top of the well casing to the ground water surface was measured with an E-tape.

Sediment samples were collected from the top one foot of sediment with large stainless steel spoons. Sample containers were eight-ounce glass with teflon-lined lids (acid/base-neutrals and purgeables) and small polyethylene cups (copper, chromium, arsenic, total organic carbon, and percent solids).

Containers for priority pollutant organics were cleaned with sequential rinses of detergent, HCl, HNO_3, distilled water, nanograde acetone, and nanograde methylene chloride, then dried at 350°F for 24 hours. Well bailers and spoons used in sediment sampling were washed with detergent and rinsed with methylene chloride before use. Samples were kept on ice after collection. Chain-of-custody procedures were followed.

ANALYSIS

Analysis was done at the EPA/WDOE Manchester laboratory except for total organic carbon in sediment which was done by Laucks Testing Laboratories, Inc., Seattle.

Priority pollutant organics were analyzed by gas chromatography/mass spectrometry following EPA method 625 (acid/base-neutrals) and EPA method 624 (purgeables). Priority pollutant analysis included compounds on the EPA Hazardous Substances List. Additional organic compounds were tentatively identified by computer-match with the Manchester laboratory spectrum library. Metals were analyzed by atomic absorbtion spectrometry following EPA methods 220.1 (copper), 218.1 (chromium), and 206.2 (arsenic). Sediment samples were digested with HNO_3 and H_2O_2 for metals analysis. Unfiltered water samples were analyzed for total metals. No analyses were done for priority pollutant pesticides, PCBs, or dioxins. Dickey Huntamer (WDOE) did the acid/base-neutrals analysis, Steve Pope (EPA) did the purgeables analysis, and Roy Araki (WDOE) did the metals analysis.

Analysis for conventional parameters in water and percent solids in sediment followed EPA (1979) Methods for Chemical Analysis of Water and Wastes. Total organic carbon in sediment was determined by loss on ignition.

Field blanks were analyzed for both the priority pollutants organics (lab. nos. 079014 and 079015) and metals (lab. no. 131454). Blank water was prepared at the EPA/WDOE Manchester laboratory by passing de-ionized water through activated carbon filters. All constituents analyzed were below detection limits in field blanks. Laboratory blanks for some of the purgeables analyses contained methylene chloride, acetone, and 2-butanone.

Spike recoveries for the organics analysis were within limits specified for the EPA Contract Laboratory Program except for the surrogate spikes 2-fluorophenol, D-5 phenol, and D-5 nitrobenzene. This problem is currently being investigated by the analyst.

RESULTS AND DISCUSSION

The results of conventional and priority pollutant analyses are in Table 1.

The analyses done on creosote showed it to contain high concentrations of a number of organic compounds classed as priority pollutants or hazardous substances. A major fraction of the creosote was low molecular weight PNAs†

†In this report, low molecular weight PNAs refer to the 2- and 3-ring compounds naphthalene, 2-methylnaphthalene, acenaphthylene, acenaphthene, fluorene, phenanthrene, and anthracene; high molecular weight PNAs refer to the 4-ring and above compounds fluoranthene, pyrene, benzo(a) anthracene, chrysene, benzoflouranthenes, benzo(a)pyrene, indeno(1,2,3-c,d) pyrene, and benzo(g,h,i)perylene.

Table 1. Results of analysis of product, ground water, site discharges, and intertidal sediment samples collected by WDOE at McFarland/Cascade wood-treating facility on Budd Inlet, February 13, 1985 (ppb unless otherwise noted).

Sample				NPDES Disch.	Seep	Storm Drain	East Bay Nearshore Sediment Transect					East Bay Off-shore Sediment		W. Bay Sediment
	Creosote	Well N-28	Well N-4	to E. Bay	to E. Bay	to W. Bay	Sta. #1	Sta. #2	Sta. #3	Sta. #4	Sta. #5	Sta. #6	Sta. #7	Sta. #8
Laboratory Number	079024	079012	079009	079010	079011	079013	079016	079017	079018	079019	079020	079021	079022	079023
Conventional Parameters														
flow (cfs)				0.C07	0.004	0.33								
temperature (°C)	N/A	9.6	10.8	10.3	6.8	9.1								
pH (units)	N/A	6.3	7.1	7.7	6.9	7.5								
spec. cond. (umhos/cm)	N/A	778	1,820	218	23,400	877								
t. susp. solids (mg/L)	N/A	850	310	14	12	29								
t. organic carbon (%)	N/A	N/A	N/A	N/A	N/A	N/A	3.5	3.2	3.8	1.9	3.8	2.4	1.6	4.2
percent solids	N/A						45.0	47.6	49.9	67.1	67.2	57.3	52.4	70.2
Aromatic Hydrocarbons														
benzene	13,000	26J	5J	5U	5U	40U	9U	4J	7U	5U	5U	7U	5U	5U
ethylbenzene	61,000	380	150	5U	5U	12J	18	5.0	7U	5U	5U	7U	5U	54
toluene	58,000	210	90	5U	5U	15J	9U	48	7U	5U	5U	7U	5U	5U
total xylenes	120,000	700	600	4J	5U	30J	9U	400	7U	5U	5U	7U	5J	5U
naphthalene	82,000,000	21,000	5,000	2U	0.15	8.1	5,800	210,000	7,200	3,500	9,600	2,400	530	100U
2-methylnaphthalene	42,000,000	5,400	1,500	2U	0.1J	4.2	790	15,000	640	640	560	200U	100J	100U
acenaphthylene	3,000,000	67	13	2U	0.11	6.1	330	400U	400U	100J	100J	200U	100J	100U
acenaphthene	44,000,000	2,500	320	2U	0.4	150	14,000	370,000	4,800	1,500	620	660	190	100U
dibenzofuran	24,000,000	1,100	1J	2U	0.1U	54	5,300	130,000	1,400	310	250	220	73J	100U
fluorene	24,000,000	1,200	58	2U	0.1U	65	5,200	200,000	1,300	670	300	200U	82J	100U
phenanthrene	80,000,000	3,000	69	2U	0.1U	65	20,000	800,000	2,900	2,000	1,100	1,300	400	100U
anthracene	5,800,000	430	17	2J	0.2	18	2,700	150,000	5,700	650	360	820	300	100U
fluoranthene	39,000,000	1,100	17	1J	0.3	36	32,000	530,000	42,000	3,100	1,300	7,300	4,900	220
pyrene	27,000,000	1,000	1J	1J	0.2	30	20,000	400,000	27,000	4,300	1,500	450	3,800	660
benzo(a)anthracene	7,200,000	240	4	2U	0.1J	6.8	8,000	95,000	7,500	670	330	3,500	1,300	100U
chrysene	5,700,000	250	4J	2J	0.2J	6.6	8,300	120,000	9,700	740	410	1,900	1,800	100U
benzofluoranthenes	4,000,000	160	2U	4	0.4	3	6,600	73,000	6,900	880	510	1,600	1,600	100U
benzo(a)pyrene	1,100,000	50	2U	2U	0.15J	2U	100U	40,000	2,700	360	190	750	680	100U
indeno(1,2,3-cd)pyrene	610,000	2U	2U	2U	0.1U	2U	100J	400U	400U	100J	100U	200U	100U	100U
benzo(g,h,i)perylene	500,000	2U	2U	2U	0.1U	2U	100J	400U	400U	100U	100U	200U	100U	100U
Phenols														
phenol	1,000,000	3,600	1U	1U	0.1U	1U	100U	400U	400U	100U	100U	200U	100U	100U
2-methylphenol	500,000	510	1U	1U	0.1U	1U	100U	400U	400U	100U	100U	200U	100U	100U
4-methylphenol	1,400,000	1,900	1U	1U	0.1U	1U	100U	400U	400U	120	100U	200U	100U	100U
2,4-dimethylphenol	510,000J	2U	2U	2U	0.1U	2U	100U	400U	400U	100U	100U	200U	100U	100U
pentachlorophenol	25,000U	1,900	92	1,700	8.6	17	100U	400U	400U	100U	100U	200U	100U	100U
Miscellaneous Organics														
bis(2-ethylhexyl) phthalate	25,000U	85U	23U	3U	0.6U	3U	760	15,000	1,100	100U	120	640	420	1,600
chlorobenzene	9,000U	40U	5U	5U	5U	40U	9U	8U	7U	5U	5U	7U	5U	10
2-butanone	54,000	110B	5JB	5JB	6JB	90U	24	38	27	10U	10U	14U	20UJ	41UJ
carbon disulfide	9,000U	40U	5U	5U	5U	40U	91	43	7U	5U	5U	7U	22	5U
2-methyl-2-pentanone	6,000J	80U	10U	10U	10U	80U	18U	16U	14U	10U	10U	14U	10U	10U
methylene chloride	12,000	84B	3JB	3JB	3JB	42JB	21B	183	16JB	9JB	5U	11JB	33	14J
acetone	39,000	360B	70UJ	5UJ	4UJ	220B	270B	200B	100B	35	35	61	120UJ	87UJ
Metals														
copper	N/A	154	84	81†	14†	14†	36.3††	69.6††	131.5††	37.4††	32.0††	62.6††	71.5††	56.6††
chromium	N/A	N/A	N/A	2†	6†	13†	38.8††	35.0††	40.2††	20.5††	20.2††	35.2††	35.2††	20.6††
arsenic	N/A	123	5	3†	15†	6†	3.0††	5.7††	10.7††	11.0††	5.5††	7.6††	7.3††	9.0††

NOTE: Sediment data are on a dry-weight basis.
†Metals data on discharges are from samples collected May 24, 1985.
††Sediment metals units are ppm.

N/A = not analyzed
J = estimated concentration
U = not detected at detection limit shown
B = analyte found in laboratory blank as well as sample

which comprised 28 percent of the sample. Lesser amounts of high molecular weight PNAs (8.5 percent), phenol/cresols (0.3 percent), and single-ring aromatic hydrocarbons (0.03 percent) were measured. Two ketones (2-butanone and 2-methylpentanone), methylene chloride, and acetone were also detected as minor constituents. The predominant compounds among the priority pollutants analyzed were the low molecular weight PNAs naphthalene and phenanthrene, each present at about 8 percent.

The water level in well N-28 was 51 1/2 inches below the top of the casing; the level in well N-4 was 93 inches. Based on data in the Applied Geotechnology report, the water elevation in well N-28 was 14.3 feet above mean lower low water. Casing elevation was not reported for well N-4.

There was evidence of substantial ground water contamination by creosote and pentachlorophenol in both wells. Well N-28, near the East Bay shoreline, had much higher contaminant levels than well N-4. During the process of sampling, a large amount of solids became suspended in well N-28 and incorporated into the samples. Although the N-28 samples were allowed to settle overnight and then decanted prior to analysis, the data for this well may overestimate concentrations of some constituents, especially PNAs which tend to be associated with particulates.

Naphthalene was the predominant PNA in ground water--well N-28 had 21,000 ug/L; well N-4 had 5,000 ug/L. Pentachlorophenol concentrations were 1,900 ug/L in well N-28 and 92 ug/L in well N-4. Applied Geotechnology also found naphthalene to be the predominant PNA in ground water. They reported 14,000 ug/L naphthalene in well N-28 and 11,600 ug/L naphthalene in well N-4 (analysis by Laucks Testing Laboratories, Inc., Seattle). Their pentachlorophenol analysis included other chlorinated phenols and is not, therefore, comparable with results from the present survey. The two data sets are compared below in Table 2. Applied Geotechnology's analyses were limited to PNAs, chlorophenols, and oil and grease.

Table 2. Comparison of WDOE and Applied Geotechnology, Inc. data on McFarland/Cascade monitoring wells N-4 and N-28.

Well Number	N-4		N-28	
Investigator	WDOE	AGI	WDOE	AGI
Sample Date	2/13/85	11/6/83	2/13/85	12/7/83
naphthalene (ug/L)	5,000	11,600	21,000	14,000
2-methyl naphthalene (ug/L)	1,500	N/A	5,400	N/A
acenaphthylene (ug/L)	13	2,060	67	160
acenaphthene (ug/L)	320	1,560	2,500	239
dibenzofuran (ug/L)	1J	N/A	1,100	N/A
fluorene (ug/L)	58	168	1,200	100
phenanthrene (ug/L)	69	152	3,000	106
anthracene (ug/L)	17	4.21	430	14
fluoranthene (ug/L)	17	142	1,100	1.4U
pyrene (ug/L)	10	13	1,000	10
benzo(a)anthracene (ug/L)	4	3.53*	240	4.5*
chrysene (ug/L)	4J		250	
benzofluoranthenes (ug/L)	2U	6.00**	160	19U*
benzo(a)pyrene (ug/L)	2U	3.29	60	9U
indeno(1,2,3-cd)pyrene (ug/L)	2U	3.6U	2U	29U
benzo(g,h,i)perylene (ug/L)	2U	5.4U	2U	43U
dibenzo(a,h)anthracene (ug/L)	N/A	9.8U	N/A	78U
pentachlorophenol (ug/L)	92	4,970†	1,900	19,900†
oil & grease (mg/L)	N/A	5u	N/A	10

*benzo(a)anthracene + chrysene
**benzo(b)fluoranthene
†includes other chlorophenols
N/A = not analyzed
J = estimated concentration
U = not detected at detection limit shown

McFarland/Cascade's NPDES discharge to East Bay had a high pentachlorophenol concentration of 1,700 ug/L. Low concentrations (4 ug/L or less) of xylene and six PNAs were also detected. The adjacent bank seep had 8.6 ug/L pentachlorophenol. The Manchester laboratory achieved lower detection limits for PNAs in the seep sample and was able to quantify a number of compounds at between 0.1 ug/L and 0.4 ug/L. Judging from its high specific conductivity, the seep represented primarily tidal waters. The storm drain to West Bay, unlike East Bay discharges, had a substantial PNA content ranging from 3 ug/L benzoflouranthenes to 150 ug/L acenaphthene. It also had a small amount of pentachlorophenol, 17 ug/L.

2-butanone, methylene chloride, and acetone were reported as present in ground water and discharge samples. These compounds were used in cleaning the sample containers and sampling equipment and/or were detected in laboratory blanks so their presence may be an artifact of sampling or analysis. (The concentrations of 2-butanone, methylene chloride, and acetone measured in the creosote sample, described earlier, are too large to attribute solely to contamination.)

Low concentrations of copper, chromium, and arsenic were characteristic of all ground water and discharge samples.

The pentachlorophenol concentration measured in the McFarland/Cascade discharge would require substantial dilution--32 to 50 fold--to be reduced below the EPA criteria of 53 ug/L (acute toxicity) and 34 ug/L (chronic toxicity) for protection of marine life (EPA, 1980). The total priority pollutant PNA concentration in the West Bay storm drain, 512 ug/L, is also above EPA's 300 ug/L criterion (acute toxicity) for these compounds.

Table 3 below summarizes the aromatic hydrocarbon and pentachlorophenol loads to East Bay and West Bay calculated from the February 13 survey. Measurement of the total contaminant load to Budd Inlet from the McFarland/Cascade site was not attempted in this survey. Since only one of the several existing seeps to East Bay was sampled, the loads in Table 3 underestimate the total loading for this time period. On the other hand, because the seeps and the West Bay storm drain are tidally influenced, average daily loads may be lower than indicated by these instantaneous measurements taken at low tide.

Table 3. Contaminant* loads to Budd Inlet from McFarland/Cascade and vicinity measured by WDOE on February 13, 1985.

Discharge	Constituent	Load (lbs/day)
Storm Drain to West Bay	low molecular weight PNAs	0.56
	high molecular weight PNAs	0.15
	single-ring aromatics	0.10
	pentachlorophenol	0.03
McFarland NPDES discharge to East Bay	low molecular weight PNAs	0.0001
	high molecular weight PNAs	0.0003
	single-ring aromatics	0.0002
	pentachlorophenol	0.06
McFarland Seep to East Bay	low molecular weight PNAs	0.00002
	high molecular weight PNAs	0.00002
	single-ring aromatics	not detected
	pentachlorophenol	0.0002

*Organics loads do not include tentatively identified compounds

The West Bay storm drain had several orders of magnitude higher aromatic hydrocarbons loads than the other two discharges. The McFarland/Cascade permitted discharge was the predominant pentachlorophenol load. The West Bay aromatic hydrocarbon loads were 0.56 pound/day low molecular weight PNAs, 0.15 pound/day high molecular weight PNAs, and 0.10 pound/day single-ring compounds. The pentachlorophenol load from the McFarland/Cascade permitted discharge was 0.06 pound/day. Based on results of the preliminary ground water evaluation, Applied Geotechnology estimated a load of 10 pounds/year of combined PNAs and chlorophenols in ground water going to Budd Inlet from McFarland/Cascade. However, an error was made in calculating this load (Applied Geotechnology, 1984). A better estimate, although still preliminary, is on the order of 450 pounds/year or about 1 pound/day (M. Adams, personal communication).

The results of sediment sample analysis showed very high PNA concentrations--up to 800,000 ug/Kg individual PNAs--in the East Bay transect near McFarland/Cascade, reduced PNA concentrations in the two East Bay samples farther off-shore, and only two individual PNAs detectable in the West Bay sample. The low PNA level in the West Bay sample in spite of a nearby source is puzzling and suggests additional samples should be collected here.

Phenol, cresols, and pentachlorophenol were not detected in sediment except for 120 ug/Kg of 4-methylphenol in one of the East Bay transect samples. This may be a function of the relatively high solubility of these compounds and/or the detection limits employed (100 to 400 ug/Kg). Puget Sound background levels for phenols and cresols are below 100 ug/Kg (Tetra Tech, in prep.).

Six other organic priority pollutant compounds were detected in sediment. Bis(2-ethylhexyl)phthalate, a widely used plasticizer, was quantified at between 120 and 15,000 ug/Kg in six of the eight samples collected. Small amounts (<100 ug/Kg) of chlorobenzene and carbon disulfide were detected in several samples. The significance of 2-butanone, methylene chloride, and acetone in sediment is questionable for reasons already explained.

The copper, chromium, and arsenic levels measured in the East and West Bay sediments, although elevated, are not unusual for a Puget Sound urban embayment.

Figure 2 depicts the horizontal distribution of low and high molecular weight PNAs in East Bay intertidal sediments near McFarland/Cascade. Concentrations peak at station #2 near the wood-treatment facility and decrease moving both to the northwest in the nearshore transect and in the offshore direction. Correcting these data for total organic carbon does not alter the direction of these gradients, indicating the observed distribution is not a simple function of carbon content, and strongly suggesting the source is McFarland/Cascade. Field observations recorded during sampling noted an oily sheen and droplets of creosote-like material at stations #1, #2, and #3 where PNA concentrations were found to be greatest.

The East Bay sediment data were compared to a summary of information on Puget Sound "toxic hot spots" (Yake, 1985). The station #2 sample at McFarland/Cascade had an especially large concentration of high molecular weight PNAs and, at 1,300 mg/Kg, is substantially more contaminated than the highest

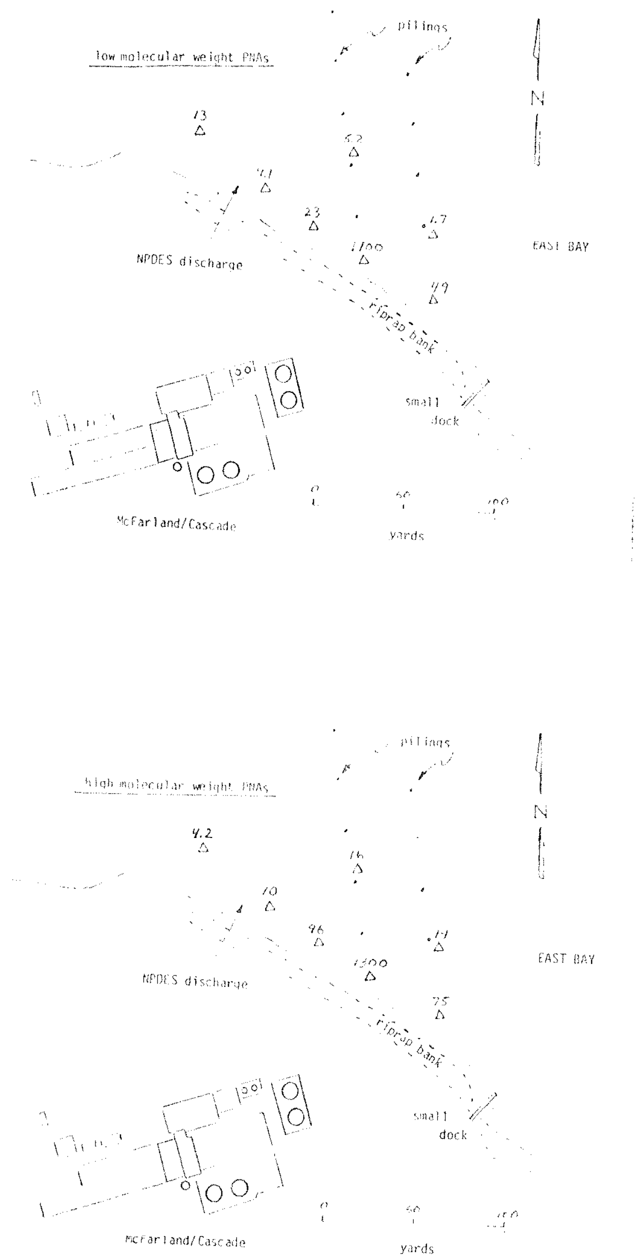

Figure 2. Horizontal distribution of PNAs in East Bay intertidal sediments adjacent to McFarland/Cascade's wood-treating facility; based on samples collected by WDOE, February 13, 1985 (mg/Kg, dry weight).

samples from Hylebos Waterway, Eagle Harbor, or Harbor Island -- the top three PNA hot spots known in Puget Sound (308 to 350 mg/Kg maximum high molecular weight PNA concentrations observed). In the limited area covered by the present survey--approximately 1,000 yd^2--it appears that PNA concentrations drop off by one to two orders of magnitude within 50 to 100 yards of station #2. Stations #1 and #3 remain sufficiently high to be classed as PNA hot spots.

The levels of PNAs and dibenzofuran measured in these East Bay sediment samples may be sufficient to harm marine life. Table 4 compares the East Bay and West Bay data with draft "apparent effects thresholds" determined by Tetra Tech, Inc. during the recent Superfund investigation of the nearshore/tideflats area of Commencement Bay. These thresholds were derived by comparisons of biological response to sediment chemistry (as measured by amphipod and oyster larvae bioassays and abundance of infauna) at stations where these data were obtained concurrently. They represent a concentration which appears likely to have deleterious effects on marine organisms. As shown in Table 4, only the West Bay sample is below apparent effects thresholds in all categories.

Table 4. Summary of PNA data on intertidal sediments near McFarland/Cascade showing potential for adverse effects on marine life (~~ug~~ mg/Kg, dry).

"Apparent Effects Thresholds"[a]			East Bay Nearshore Transect					East Bay Offshore		West Bay
			Sta. #1	Sta. #2	Sta. #3	Sta. #4	Sta. #5	Sta. #6	Sta. #7	Sta. #8
lmw PNAs	5.2	(diversity & toxicity)	/49/	/1700/	/23/	/9.1/	/13/	/5.2/	1.7	0.10U
hmw PNAs	12	(reduced infaunal diversity)	/75/	/1300/	/96/	10	4.2	/16/	/14/	0.88
hmw PNAs	17	(toxicity in amphipod/ oyster larvae bioassays)	/75/	/1300/	/96/	10	4.2	16	16	0.88
dibenzofuran	0.54	(diversity & toxicity)	/5.3/	/130/	/1.4/	0.31	0.25	0.72	0.08J	0.10U

[a]Draft findings, Commencement Bay Nearshore/Tideflats Remedial Investigation (Tetra Tech, Inc., in prep.).
/ / = above threshold
U = not detected at detection limit shown
J = estimated concentration

An additional 55 organic compounds, shown in Table 5, were tentatively identified in samples collected during the present survey. These compounds were primarily substituted aromatic hydrocarbons, especially benzenes and naphthalenes. The concentrations estimated for a number of these compounds equaled or exceeded those for the priority pollutants previously discussed.

Table 5. Compounds tentatively in product, ground water, site discharges, and intertidal sediment samples collected by WDOE at McFarland/Cascade wood-treating facility on Budd Inlet, February 13, 1985 (ppb).

Sample	Creosote	Well N-28	Well N-4	NPDES Disch. to E. Bay	Seep to E. Bay	Storm Drain to W. Bay	East Bay Nearshore Sediment Transect Sta. #1	Sta. #2	Sta. #3	Sta. #4	Sta. #5	East Bay Off-shore Sediment Sta. #6	Sta. #7	W. Bay Sediment Sta. #8
Laboratory Number	079024	079012	079009	079010	079011	079013	079016	079017	079018	079019	079020	079021	079022	079023
1,2,4-trimethylbenzene	680,000	1,100J	1,100J	--	--	150J	--	280J	--	--	--	--	--	--
1-ethyl-2-methylbenzene	1,000,000	1,600J	--	--	--	73J	--	1,000J	--	--	--	--	--	--
propylbenzene	--	330J	46J	--	--	--	--	300J	--	--	--	--	--	--
1,2,3,4-tetramethylbenzene	--	420	170	--	--	44	--	--	--	90J	--		--	--
(1-methyl-2-cyclopen-1-yl) benzene	--	--	1,000	--	--	--	--	--	--	--	--	--	--	--
1-ethyl-4-methylbenzene	--	5,500	--	--	1.2	530J	--	--	--	--	--	--	--	--
1-methyl-2-propylbenzene	--	130	--	--	--	--	--	--	--	--	--	--	--	--
1,3-diethyl-5-methylbenzene	--	320	--	--	--	--	--	--	--	--	--	--	--	--
1-butynlbenzene	--	--	--	--	--	78	--	--	--	--	--	--	--	--
1,2,3-trimethylbenzene	--	--	--	--	--	200J	--	--	--	--	--	--	--	--
4-ethyl-1,2-dimethylbenzene	--	--	--	--	--	--	--	--	--	80J	--	--	--	--
1-propenalbenzene	--	--	--	--	--	1,800J	--	--	--	--	--	--	--	--
2-ethylnaphthalene	--	2,200	210	--	--	--	--	120,000	--	--	--	--	--	--
1,5-dimethylnaphthalene	24,000,000	--	310	--	--	240	4,500	300,000	--	1,900	--	--	--	--
1,2-dimethylnaphthalene*	--	5,500	79	--	--	44	--	--	--	2,900	--	--	--	--
1,4,6-trimethylnaphthalene	--	2,400	--	--	--	38	--	--	--	--	--	--	--	--
1,2,3,4-tetrahydronaphthalene	--	--	--	--	--	23	--	--	--	--	--	--	--	--
2,3-dimethylnaphthalene	--	--	--	--	--	--	12,000	--	--	--	--	--	--	--
1,4-dimethylnaphthalene	--	--	--	--	--	--	130	130,000	--	1,100	530	--	--	--
1-methylnaphthalene	--	--	--	--	--	--	--	780,000	--	2,800	2,100	--	--	--
1-ethylnaphthalene	--	--	--	--	--	--	--	--	--	--	540	--	--	--
1,7-dimethylnaphthalene	--	--	--	--	--	--	--	--	--	--	1,100	--	--	--
2-methylnaphthalene	--	500J	--	--	--	240J	--	--	--	--	--	--	--	--
1,4-dihydro-1,4-methano naphthalene	--	630J	--	--	--	--	--	--	--	--	--	--	--	--
1-isocyanonaphthalene	--	--	76	--	--	--	--	--	--	--	--	--	--	--
2-methyl-1-naphthylisocyanide	--	39	--	--	--	--	--	--	--	--	--	--	--	--
4H-cyclopenta[DEF] phenanthrene	38,000,000	--	15	--	--	--	--	--	--	--	--	--	--	--
2-methylanthracene*	--	--	10	--	--	26	--	--	--	--	--	--	--	--
11H-benzo(a)fluorene	--	--	--	--	--	--	15,000	--	--	--	--	--	--	--
benzo[B]thiophene	--	--	--	--	31	290	--	--	--	1,800	--	--	--	--
dibenzothiophene	18,000,000	--	--		--	23	--	270,000	--	--	--	--	--	--
2,3,4-trimethylthiophene	--	--	27	--	--	--	--	--	--	--	--	--	--	--
6-methyl-benzo[B]thiophene*	--	440	240	--	2.1	--	--	--	--	--	--	--	--	--
4-methyl-benzo[B]thiophene	--	680	--	--	1.6	--	--	--	--	--	--	--	--	--
azulene	--	--	--	--	--	560J	--	--	--	--	--	--	--	--
2,3-dihydroindene	--	--	160	--	--	--	--	--	--	--	--	--	--	--
2,3-dihydro-4,7-dimethyl-1H-indene	--	--	59	--	--	--	--	--	--	--	--	--	--	--
2,3-dihydro-4-methyl-1H-indene	--	980	510	--	--	170	--	--	--	--	--	--	--	--
1-ethylidene-1H-indene	110,000,000	--	--	--	--	--	--	--	--	--	--	--	--	--
2,3-dihydro-1-methyl-1H-indene	--	--	--	--	--	91J	--	--	--	--	--	--	--	--
1-methyl-1H-indene	--	--	--	--	--	70J	--	--	--	--	--	--	--	--
4-methyldibenzofuran	--	--	--	--	--	48	5,800	--	--	--	--	--	--	--
7-methylbenzofuran	--	--	2,700	--	--	70	--	--	--	--	--	--	--	--
benzofuran	--	--	--	--	--	120J	--	--	--	--	--	--	--	--
[1',1'-biphenyl]-carboxy aldehyde	9,300,000	--	29	--	--	48	--	--	--	--	--	--	--	--
1,1'-biphenyl	--	--	470	--	--	--	--	--	--	540	910	--	--	--
biphenylene	--	--	50	--	--	--	--	--	--	--	--	--	--	--
isoquinolone	--	--	--	--	--	41	--	--	--	--	--	--	--	--
carbazole	4,000,000	--	--	--	--	--	680	--	--	--	--	--	--	--
2,3,4,6-tetrachlorophenol	--	180	--	140	2.9	--	--	--	--	--	--	--	--	--
2-chloro-1,3,5-cycloheptatriene	190,000J	--	--	--	--	--	--	--	--	--	--	--	--	--
3-phenyl-2-propenal	--	570	800	--	--	40	--	--	--	--	--	--	--	--
alpha-methylbenzeni acetaldehyde	--	370	--	--	--	--	--	--	--	--	--	--	--	--
oxime(E)-4-methylbenz-aldehyde	--	--	60	--	--	--	--	--	--	--	--	--	--	--
1-(methylphenyl)-ethanone	--	670	--	--	--	--	--	--	--	--	--	--	--	--

NOTE: Sediment data are on a dry-weight basis.
-- = not detected
J = estimated value.
* = or isomer

Memo to Tom Eaton
Receiving Environment Survey in Budd Inlet at McFarland/Cascade, February 13, 1985

SUMMARY

The major findings of this survey are as follows:

1. Analysis of ground water in wells N-28 and N-4 confirmed earlier findings by Applied Geotechnology, Inc. of high PNA and pentachlorophenol concentrations.

2. PNAs and pentachlorophenol were detected in the McFarland/Cascade NPDES discharge, an adjacent seep, and a storm drain to West Bay. Concentrations of individual PNAs were in the range of 1 to 4 ug/L in the permitted discharge, 0.1 to 0.4 ug/L in the seep, and 3 to 150 ug/L in the storm drain; pentachlorophenol concentrations were 1,700 ug/L, 8.6 ug/L, and 17 ug/L, respectively.

3. The West Bay storm drain constituted the largest PNA load of the three discharges sampled. The low molecular weight PNA load was 0.56 pound/day, and the high molecular weight PNA load was 0.15 pound/day. Corresponding loads in the McFarland/Cascade permitted discharge and adjacent seep were several orders of magnitude lower.

4. The pentachlorophenol loads measured were 0.06 pound/day in the permitted discharge, 0.03 pound/day in the West Bay storm drain, and 0.0002 pound/day in the seep.

5. The concentrations of PNAs present in the West Bay storm drain and pentachlorophenol in McFarland/Cascade's permitted discharge would require dilution in the receiving waters to be reduced below levels considered toxic to marine life.

6. Evidence of creosote in the form of oily sheens and droplets of a creosote-like substance were observed in the East Bay intertidal zone near McFarland/Cascade.

7. High concentrations of PNAs were found in East Bay intertidal sediments adjacent to McFarland/Cascade. Concentrations of high molecular weight PNAs ranged from 4.2 to 1,300 mg/Kg, with the highest levels occurring in those samples collected nearest the wood-treating facility. The higher concentrations measured are sufficient to rank this site among the Puget Sound PNA "hot spots." However, results of the present survey suggest the horizontal extent of contamination may be limited to a relatively small area.

8. The levels of PNAs found in East Bay intertidal sediments are potentially toxic to marine life.

9. Phenol and pentachlorophenol were not detected in sediment. One cresol (4-methyl phenol) was detected in a single sediment sample.

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RECOMMENDATIONS

Short-Term:

1. Collect several additional sediment samples in West Bay to verify absence of significant creosote contamination.

2. Conduct an expanded sediment survey in East Bay to determine the horizontal and vertical extent of creosote contamination.

3. Analyze for PNAs and pentachlorophenol in samples from McFarland/Cascade seeps not included in the present survey.

Long-Term:

1. Eliminate on-going sources of contamination to Budd Inlet, probably through controlling contaminated ground water migrations from McFarland/Cascade.

2. Resolve sediment contamination, probably by requiring removal of all sediments exceeding the apparent effects threshold for any compound.

AJ:cp

Attachments

REFERENCES

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